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Dr. Gottfried Ruegenberg in Düsseldorf has been named as inventor.

Dr. Gottfried Ruegenberg in Düsseldorf
Procedure and device for the production of paper stretchable on all sides
Patented in the German Empire as of August 5, 1937
Patent grant made public on May 23, 1940.

The declaration has been made according to § 2, Section 2 of the ordinance of April 28, 1938, that protection is to include the country of Austria.

The subject of the invention is a procedure for the production of paper stretchable on all sides by creping the paper sheets first in the traverse direction and thereafter in the longitudinal direction.

It is known that the stretchability of papers can be increased by creping them in one direction, i.e. the longitudinal direction. This creping is done predominantly by means of creping cylinders and scrapers. Paper thus creped has, on the one hand, the disadvantage that crepe folds can be easily straightened out by tensile stress on the paper sheet, and on the other hand, that its stretchability is increased only in the longitudinal direction, while traverse stretchability, which is anyway inferior to longitudinal stretchability owing to the direction of the fibers, is reduced rather than increased. A number of procedures are known that aim at increasing the traverse stretchability of materials by reducing their width, and by the accumulation of the material in crepe folds extending in a longitudinal direction. One procedure e.g. is based on the principle that the material in question is carried along by two elastic webs running under compression with an identical direction of movement and reducing their width while moving. According to a further procedure, the aforementioned elastic webs are replaced by a rotating body with a curved axis.

Various procedures are also known that aim at obtaining stretchability of paper on all sides and similar materials. For example, treatment of a material, previously creped traversely by means of creping cylinder and scraper, according to one of the aforementioned longitudinal creping procedures has been attempted, thus creating a double creping with perpendicularly crossing folds. A different double creping procedure has the material that is to be creped gripped

between pliable bodies under compression, and shortened together with these in the longitudinal and the traverse direction simultaneously.

According to a further double creping procedure, the material is upset into diagonally crossing crepe folds on two creping cylinders with slanted scrapers. Furthermore, a procedure is known for the production of insulated mats made of elastic material, according to which bulges are at first made to protrude from the fibrous material of the mats and are later slightly pressed down by a press or roll mill. The mat, which is meant to insulate against heat and sound, is thus able to achieve a greater resistance to compression. Furthermore, processing of paper for wrapping purposes in such a way that it develops a cushioning effect and can absorb perpendicular pressure on its surface has been suggested. To this end, an ordinary crepe paper was fitted with imprinted indentations. In this way, a paper stretchable on all sides cannot be obtained.

Furthermore, it has been suggested to fit paper with deep, highly distinctive longitudinal and traverse grooves, between which remain rectangular plates that have a smooth surface and no folds. Also the grooves running between these plates are made smooth and without folds.

Also it is known to have bump-like elevations embossed in paper at the expense of the fibers of the paper, so that the paper sheet is weakened at the point of embossing. While double crepe papers produced according to known procedures feature crossing longitudinal and traverse crepe folds, according to the invention, the accumulation of material on all sides is located in numerous fold nests, distributed evenly over the paper surface, i.e. the accumulation of material is located in short little folds, which cluster around the centers of many spots densely spread over the surface. All these fold-nests contain a separate and independently accumulated material reserve. In this respect, such a paper differs from known papers, which, for decorative purposes, bear a wrinkling, created by moistening and subsequent drying, that in a decorative way is arranged around numerous spots distributed over the paper sheets. By arranging these groups of short little folds in an offset sequence, the delimitation and independence of one from another are further stressed. In achieving this, the paper sheet processed according to the invention is to obtain a greater resistance to tensile stress on the paper sheet from any direction, contrary to known crepe papers whose crepe folds can easily be straightened out in the direction of original formation.

The production process can at first be implemented in an actually known way by creping the originally smooth paper sheet between rollers bearing wave shaped profiles, preferably in several steps. To this end, as usual, the paper sheet is led through a number of driven pairs of rollers whose surfaces are wave shaped in a longitudinal section. The rollers of each pair are engaged in such a way that the wave apex of one roller always faces the wave trough of the other roller. The depth of engagement of the first of these pairs is so slight that the paper sheet, inserted

into it, is molded, without undue friction, into a soft undulation parallel to the direction of movement. The waves produced in this way are deepened, with the distance between them decreasing, by passing through subsequent additional pairs of rollers, whose depth of engagement becomes deeper each time, with the respective wave partition becoming smaller. As state of the art, the paper is, in this way, contracted fan-like towards the center without detrimental stress from friction or traction.

According to the invention, the paper sheet, moving between rollers moving on counter-rollers which feature bump-shaped elevations and corresponding indentations on their surfaces, is likewise creped in the longitudinal direction. At the same time, these bump-shaped elevations and indentations serve the purpose of distributing equally the paper sheet creped in the traverse and the longitudinal direction, and of fixing it in such a way that the local accumulations are preserved on the paper surface.

In another working cycle, the paper surface accumulated in the elevated points is laid down in folds by pressing the bumps protruding from the paper sheet back down towards the paper level. This is done, depending on the subtlety and the arrangement intended for the folds, between one or several pairs of rollers with a smooth or correspondingly marked surface. In this working cycle, it is useful for the roller touching the bump-bearing side of the paper sheet to have a certain advance slip of surface movement compared to the counter roller, enabling the elevated parts of the paper surface to be drawn between the rollers before these have reached their deepest point of engagement, and thus avoiding squeezing off of the elevated parts backwards compared to the direction of movement, and loss, in part, of accumulations of material.

The pair of rollers which is to affect the creping of the paper sheet in the longitudinal direction may advantageously differ in special kinematic conditions from the normal conditions of embossing calenders.

According to the invention, these provide for the paper sheet to be drawn and rolled steadily, on a continuously running traverse line, into the indentations of the counter roller by the elevations of the first roller, which are advantageously arranged in an offset sequence. This unrestrained drawing and rolling-in is to be achieved by allowing the surface of that roller, which bears an extended indentation profile, a higher turning speed compared to the surface of the counter roller.

An advantageous rolling relation is achieved with an arrangement in which the lowest points of the circumference of one roller and the highest points on the circumference of the counter roller coincide with the theoretical rolling circles of the roller system.

This has the advantage that the formation of bumps on the paper surface is not achieved at the expense of stretching the fibers. Rather, the paper surface is creped in the longitudinal

direction. In the process, the paper surplus is collected between the bumps in the form of small folds.

The drawings in Figures 1 to 8 schematically illustrate the operation of the procedure.

Figures 1, 2 and 3 show a sector of a paper sheet during creping in the traverse direction. Figure 1 presents a bird's eye view of the paper sheet, and Figure 2 shows five different cross sections a, b, c, d, e of the same, at equal distance from one another. This creping is achieved in a known manner by means of a corresponding number of mutually engaging pairs of rollers, whose surfaces are wave-shaped in longitudinal section, as shown in Figure 4. The wave distance and engagement depth of these roller pairs, which follow at a certain distance from one another, are different. The smooth paper sheet is inserted between the rollers with the greatest wave distance and the lowest engagement depth and there receives a softly undulated surface, as e.g. shown in Figure 2 at a.

Cross sections b, c, d and e of Figure 1 illustrate the gradual deepening of the undulation, coupled with a shortening of the wave distance, which results from the paper passing through the subsequent pairs of rollers. After having achieved the desired degree of creping, as e.g. shown in Figure 2 at e, the undulation of the paper surface can be modified in steps up to any grade of fineness, without any detrimental stress from traction or friction. Thus Figure 3 shows the singular subdivision of the waveform from Figure 2 at e.

The paper sheet, thus undulated longitudinally in advantageous division and depth, is now also creped longitudinally between two rollers moving on rolling contact, whose surfaces feature specific elevations and indentations; simultaneously, the paper accumulated in longitudinal and traverse direction is distributed evenly around the centers of the bumps which were made to protrude from the paper sheet in this way.

As the bumps are arranged in an offset sequence, the bumps lie in rows arranged to form a certain angle with the creping direction. Apart from the possibility of an especially dense arrangement of the bumps, increased elasticity of the paper sheet and a greater resistance to tensile stress are achieved. This offset sequence arrangement is provisioned in the embodiment form of the procedure described below.

Figures 5, 6 and 7 show, at an enlarged scale, the engagement sector of such a pair of rollers A-B in cross section, i.e. in three different engagement positions. f, g and h are elevations, in this case shaped spherically, on the surface of the one roller. They roll off into indentations i, k and l of the counter roller, which are extended in the cross section of the roller, i.e. in its rotating direction. m and n are the rolling circles of the roller system, which will, on mutual gearwheel drive, coincide with the reference circle of the gearwheels. Owing to the fact, that the surface of roller B is located outside its rolling circle n, and the surface of roller A inside its rolling circle m, the motion of rotation of the surface of B is accelerated compared to the surface of A, so that

at any rate the lowest points of the counter roller have the same speed or a higher speed than the bump-bearing roller. In the same ratio with this acceleration, the indentations of roller B must be extended in the direction of movement, compared to the corresponding elevations of A. In this respect, the ideal surface formation of the rollers can be obtained by letting the finished engraved roller A engage roller B while determining the ratios of diameters and rolling circles in the aforementioned manner, e.g. by letting an engraved roller A, made from hard material, engage roller B, made from soft, e.g. compressed material; or by etching counter roller B when engaged by finished roller A. With the embodiment form of roller A featuring spherical elevations, the cross section lines of the indentations of counter roller B would take an approximately cycloid form in this case.

The paper surface, molded after leaving this pair of rollers with bump-shaped elevations or corresponding indentations, can now be further shaped between one or several pairs of rollers, so that the paper surface accumulated in the elevated points can be made to form small folds, the arrangement of which is determined by the way in which the surface of those rollers is engraved. In order to avoid the pushing down backwards of the elevations of the paper sheet, compared to the direction of movement in this process of smoothing, it is advantageous to let the surface of one roller have an advance slip compared to the other.

Figure 8 e.g. shows in bird's eye view a paper sheet formed according to the invention, which bears fold-like creped material accumulations in an offset sequence in many locations spread over the surface.

Claims

1. Procedure for the production of paper stretchable on all sides by creping a paper sheet first in the traverse direction, thereafter in the longitudinal direction, characterized in that the paper, which has been creped in traverse direction, is drawn over bumps spread over the surface, and that the paper surplus accumulated by the creping in traverse and longitudinal direction is deposited in folds between the bumps.

2. Procedure according to Claim 1, characterized in that the bumps are made to protrude in offset rows, so that the depressions surrounding the bumps follow lines crossing each other and forming an oblique angle with the direction of movement of the paper sheet.

3. Procedure according to Claims 1 and 2, characterized in that the material accumulations, required to cover the bump-like elevations, are fixed in folds that run radially from the peaks of the bumps towards the depressions surrounding the bumps.

4. Procedure according to Claims 1 to 3, characterized in that the surface of one of the rollers serving to extrude the bumps has an advance slip compared to the surface of the other in

such a way that the paper, already creped in longitudinal waves, is unwound in a continuously running traverse line on the roller surface and rolled into the indentations of the counter roller.

5. Procedure according to Claims 1 to 4, characterized in that the bumps protruding from the paper sheet are pressed back down evenly into the paper level, and about vertically to the paper level, by one pair or several pairs of smooth or engraved rollers.

6. Device for the implementation of the procedure according to Claims 1 to 5, characterized in that the lowest points of the counter roller have the same speed as or a greater speed than the highest points of the bump-bearing roller, with indentations (i, k, l) of the counter roller being extended in the direction of movement proportional to the speed difference compared to elevations (f, g, h) of counter roller A.

7. Device according to Claims 1 to 6, characterized in that the surface of one smooth or roughened roller has an advance slip compared to the other roller in such a way that the bumps can be pressed down evenly and about vertically to the paper level.

8. Paper stretchable on all sides, produced according to Claims 1 to 7, characterized in that the paper is accumulated in folds which lie between bumps extruded from the paper sheet and distributed over the surface.

9. Paper stretchable on all sides, produced according to Claims 1 to 7, characterized in that the paper is accumulated in numerous points, evenly distributed over the surface, in the form of folds arranged around the center of these points and forming a material reserve in the paper surface.

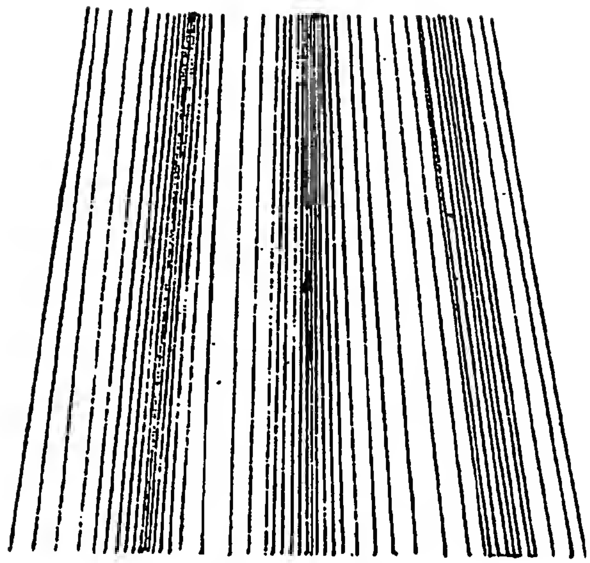

Figure 1

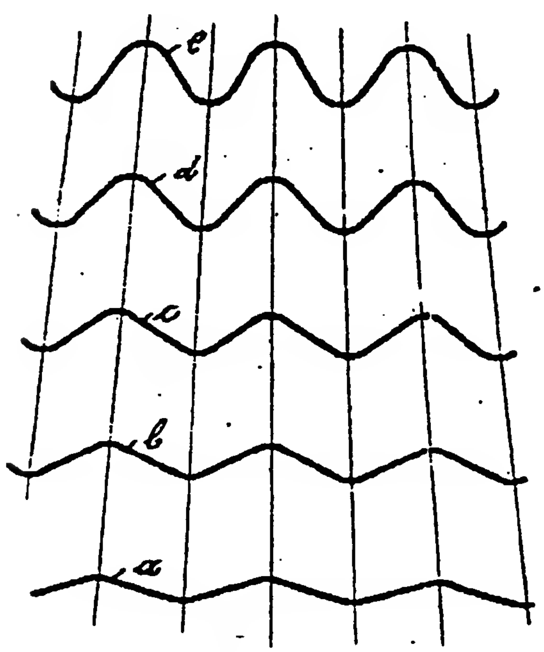

Figure 2

Figure 3

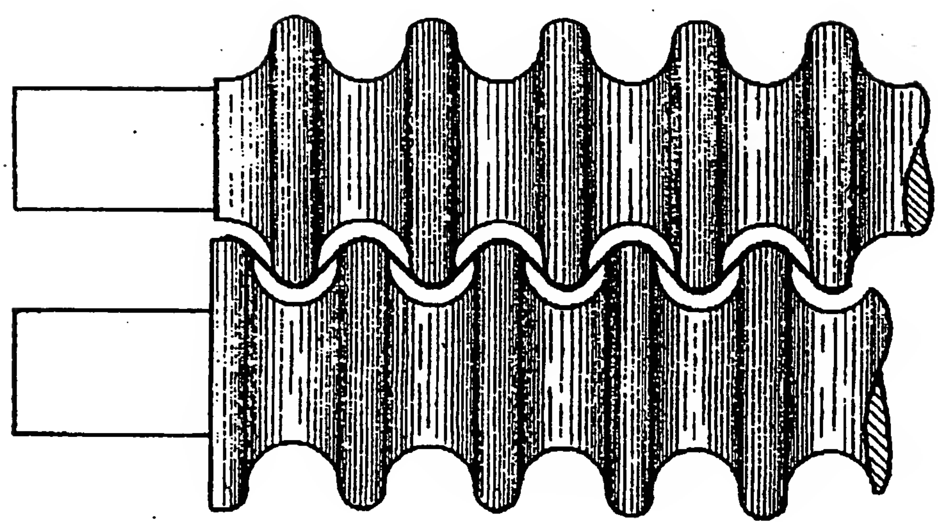

Figure 4

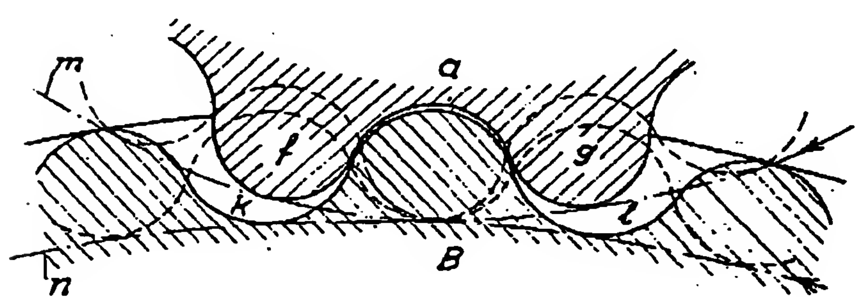

Figure 5

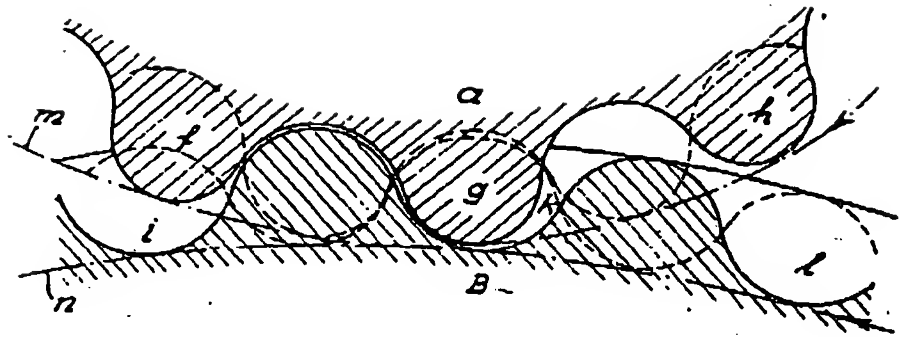

Figure 6

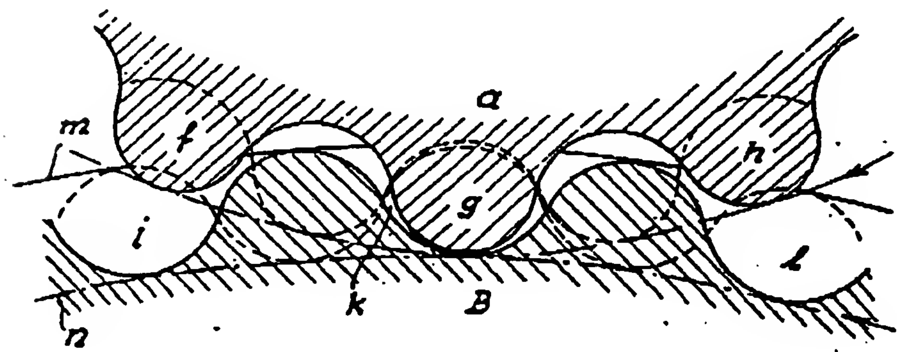

Figure 7

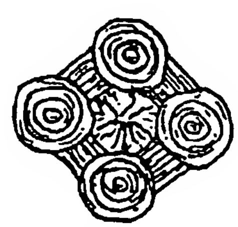

Figure 8